

A critical checklist of the Odonata of Portugal

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ABSTRACT

The Odonata checklist of continental Portugal, Madeira and the Azores includes 65 species. Besides *Sympetrum nigrifemur*, an endemic of Madeira and the Canary Islands, and the unique population of the Nearctic *Ischnura hastata* in the Azores, the species composition reflects a higher proportion of western Mediterranean and Ethiopian elements than any other European country. An isolated occurrence of *Coenagrion pulchellum* was confirmed. Due to obvious misidentifications and to the loss of voucher specimens of questionable species, 22 taxa were rejected. Future records of additional species are predicted.

INTRODUCTION

Portugal is situated in the west of the Iberian Peninsula and thus at the westernmost edge of Europe. Politically, the Atlantic archipelagos of Madeira, the Azores, and the Selvagens Islands also belong to Portugal. The archipelago of Madeira consists of Madeira, Porto Santo and the three Desertas Islands. Nine islands make up the Azores: Faial, Corvo, Flores, Pico, São Jorge, Graciosa, Terceira, São Miguel and Santa Maria. Odonata have been recorded on all listed islands (e.g. Malkmus 2002).

In comparison with other European countries systematic field mapping in Portugal is still in an early stage. This situation is hard to explain, because Portugal hosts a very distinct fauna. This includes *Sympetrum nigrifemur*, which is endemic to Madeira and the Canary Islands, a unique European population of *Ischnura hastata* from the Azores, all Ibero-Maghrebian and western European endemics, and, finally, a good number of Ethiopian species.

Several previous works provide checklists of Portuguese Odonata (Selys & Hagen 1850; McLachlan 1880; Santos 1883; Girard 1891; Seabra 1937, 1942; Nogueira & Silva 1970; Aguiar & Aguiar 1985a). In other papers the Portuguese fauna is treated in the context of the entire Iberian odonate fauna (Hagen 1866; Navás 1906, 1907, 1924; Compte Sart 1965, 2004; Ocharán 1988). A problem with all checklists cited above is their lack of congruency, owing to many contentious species records that have been variously treated by the different authors.

The present paper tests the reliability of all critical Portuguese Odonata records. Our aim is to provide a well-founded checklist on which there is full consensus to serve as a basis for future odonatological work. Currently, interest in the Portuguese Odonata fauna, by both local workers and foreign visitors, is growing, as may best be seen from the increasing number of recent entries in the Portuguese bibliography (Ferreira & Weihrauch 2005). We therefore consider it opportune to present a reliable checklist.

METHODS

All available literature (see Ferreira & Weihrauch 2005) was critically analysed on the basis of zoogeographic considerations. We refrained from using the distribution maps of Malkmus (2002) due to their lack of reliable references. Additionally, crucial specimens in the Portuguese collections of the Museu Zoológico da Universidade de Coimbra (MZCP), and the Instituto de Investigação Científica Tropical – Centro de Zoologia (IICT) were examined. We also studied the collection gathered in the 1980s by Serafim and Carlos Aguiar. A list of odonate holdings in the Natural History Museum of the University at Ponta Delgada, the Azores, was provided by V. Vieira and A. Cordero (in litt.).

Hoping to identify a second Madeiran *Ischnura* species, we utilized information provided by A. Cordero (in litt.) concerning his collecting experience in Madeira and his examination of the odonate collection at the Zoology Department of the University of Madeira. We also contacted D. Goodger, The Natural History Museum, London, to search for a series of this *Ischnura* sp. collected in Porto Santo (Gardner 1963). Due to the absence of voucher specimens of *Ophiogomphus cecilia*, published sites were visited to ascertain the suitability of the habitat and to verify the presence of the species. Larvae identified as *O. cecilia* in limnological studies were also re-examined.

RESULTS

Our checklist includes 65 species (Tables 1, 2), the historical and/or current occurrence of which in Portugal was confirmed. As *Ischnura hastata* and *Sympetrum nigrifemur* were exclusively recorded from the Atlantic islands, 63 species were regarded as continental Portuguese elements. *Calopteryx haemorrhoidalis* and *Cordulegaster boltonii* are represented by more than one subspecies, the status of which needs further analysis. A total of 17 species and additionally five subspecies records could not be confirmed (Table 3). Consequently, they were rejected from the checklist.

Notes on selected species

The notes are ordered from 1-30, as referenced in Tables 1-3. Quotations from Portuguese and Spanish sources have been translated by the authors.

- 1 Wing pattern and body size of *Calopteryx haemorrhoidalis* in Portugal are highly variable. The species is considered polytypic by some authors, with the nominotypical subspecies occurring in southern Europe from Italy to Portugal, *C. h. occasi* Capra in southern France and *C. h. asturica* Ocharán in northern Spain. The latter was also recorded from the extreme north of Portugal (Ocharán Larrondo 1987). Some Portuguese specimens show the characteristics of ssp. *occasi* (e.g. Santos 1883; S. Ferreira, J.M. Grosso-Silva unpubl.). This also applies to *C. h. almogravensis* described by Hartung (1996) from southwestern Portugal. Jahn (1996a) also collected a series of this local population and considered the very small specimens to be a dwarf variety resulting from the singular climate of the Atlantic coast. Following this plausible assessment we reject the subspecific rank of *almogravensis* and consider it an infrasub-specific entity. An improved taxonomic understanding of *C. haemorrhoidalis* in Iberia will be the subject of a future investigation.
- 2 *C. virgo meridionalis* was originally reported as "*Libellula virgo* Linnaeus". McLachlan (1880) was the first to assign the Portuguese population to ssp. *meridionalis*. The record of the nominotypical subspecies in Braga district, as mentioned by P. Jahn in Jödicke (1996a), was necessarily rejected. However, the coloration of females in northern Spain differs from typical *meridionalis* (Ocharán Larrondo 1987).
- 3 *C. xanthostoma* – previously considered a subspecies of *C. splendens* – was reported as "*C. splendens* Harris" by Girard (1891), demonstrating a lack of differentiation. Götz (1923) described *C. splendens pfeifferi* from Portugal. It was shown by van Rosen (1991) that *pfeifferi* is a synonym of *xanthostoma*.
- 4 A female of *Lestes sponsa*, also listed by Williams (1990), is among the MZCP specimens with a misleading "Coimbra" label (see Discussion). We were not able to locate this specimen in the collection, so it must be considered to be lost. Aguiar & Aguiar (1985a) doubted the reliability of the "Coimbra" specimen but listed *L. sponsa* for Portugal with the remark that it needs confirmation. We reject the species due to the lack of any voucher specimens.
- 5 "*Libellula puella*" was reported as "common" in Terceira, Azores (Sampaio 1904). The identity of this species is unclear. It may be that it was confused with *Ischnura hastata*. *Coenagrion puella* must be omitted from the Azorean fauna for zoogeographical reasons.
- 6 Ocharán (1988) omitted *C. pulchellum* from the Iberian dragonfly fauna, because none of the Spanish records was confirmed. In fact, the species was not properly recorded before 1986 in Spain (Anselin & Hoste 1996). It was listed in Portuguese checklists (Seabra 1942; Nogueira 1970; Aguiar & Aguiar 1985a) solely on the basis of an old, unsubstantiated record by Girard (1891). Surprisingly, at MZCP we came across three specimens labelled as *C. pulchellum* from Portugal (cf. Williams 1990): two of them, a male and a female, were in such a bad condition that they could not be identified; the third, a male, was considered to be typical *pulchellum*. This specimen originated from Arzila near Coimbra, leg. Carla Frias on 19 May 1987.

Table 1. Odonata checklist of Portugal — species from continental Portugal, with references to the first records. 'Note' refers to comments on selected species.

Taxa	Continental Portugal	Note
Calopterygidae		
<i>Calopteryx haemorrhoidalis</i> (Vander Linden)	Selys & Hagen (1850: 279)	1
<i>virgo meridionalis</i> Selys	Vandelli (1797)	2
<i>xanthostoma</i> (Charpentier)	McLachlan (1880)	3
Lestidae		
<i>Lestes barbarus</i> (Fabricius)	Selys & Hagen (1850: 161, 279)	-
<i>dryas</i> Kirby	Santos (1883)	-
<i>macrostigma</i> (Eversmann)	Selys (1887)	-
<i>virens</i> (Charpentier)	Charpentier (1825: 8)	-
<i>viridis</i> (Vander Linden)	Selys & Hagen (1850: 149, 279)	-
<i>Sympecma fusca</i> (Vander Linden)	Santos (1883)	-
Coenagrionidae		
<i>Ceragrion tenellum</i> (de Villers)	Santos (1883)	-
<i>Coenagrion caerulescens</i> (Fonscolombe)	Girard (1891)	-
<i>mercuriale</i> (Charpentier)	Selys & Hagen (1850: 224, 279)	-
<i>puella</i> (Linnaeus)	McLachlan (1880)	-
<i>pulchellum</i> (Vander Linden)	Girard (1891)	6
<i>scitulum</i> (Rambur)	Seabra (1937)	-
<i>Enallagma cyathigerum</i> (Charpentier)	Santos (1883)	-
<i>Erythromma lindenii</i> (Selys)	McLachlan (1880)	-
<i>viridulum</i> (Charpentier)	Seabra (1937)	-
<i>Ischnura graellsii</i> (Rambur)	Selys & Hagen (1850: 185, 279)	-
<i>pumilio</i> (Charpentier)	Seabra (1937)	-
<i>Pyrrhosoma nymphula</i> (Sulzer)	McLachlan (1880)	-
Platycnemididae		
<i>Platycnemis acutipennis</i> Selys	McLachlan (1880)	-
<i>latipes</i> Rambur	Selys & Hagen (1850: 168, 279)	-
Aeshnidae		
<i>Aeshna affinis</i> Vander Linden	Selys & Hagen (1850: 125, 279)	-
<i>cyanea</i> (O.F. Müller)	Selys & Hagen (1850: 279)	-
<i>isocles</i> (O.F. Müller)	Girard (1891)	-
<i>juncea</i> (Linnaeus)	Santos (1883)	-
<i>mixta</i> Latreille	Selys & Hagen (1850: 279, 396)	-
<i>Anax ephippiger</i> (Burmeister)	Aguiar & Aguiar (1985b)	-
<i>imperator</i> Leach	Selys & Hagen (1850: 111, 279)	-
<i>parthenope</i> Selys	Seabra (1937)	-
<i>Boyeria irene</i> (Fonscolombe)	McLachlan (1880)	-
<i>Brachytron pratense</i> (O.F. Müller)	Seabra (1937)	-
Gomphidae		
<i>Gomphus graslinii</i> Rambur	McLachlan (1880)	-
<i>pulchellus</i> Selys	Selys & Hagen (1850: 384, 396)	-
<i>simillimus</i> Selys	Selys & Hagen (1850: 92, 279)	-
<i>Onychogomphus costae</i> Selys	Jahn (1996b)	-
<i>forcipatus unguiculatus</i> (Vander Linden)	Selys & Hagen (1850: 100, 279)	17
<i>uncatus</i> (Charpentier)	Girard (1891)	-
<i>Paragomphus genei</i> (Selys)	Selys (1887)	-

Taxa	Continental Portugal	Note
Cordulegasteridae		
<i>Cordulegaster boltonii</i> (Donovan)	McLachlan (1880)	20
Corduliidae		
<i>Macromia splendens</i> (Pictet)	Navás (1924)	-
<i>Oxygastra curtisii</i> (Dale)	Erichson (1838: 236)	21
Libellulidae		
<i>Brachythemis leucosticta</i> (Burmeister)	Moura (1960)	-
<i>Crocothemis erythraea</i> (Brullé)	Selys & Hagen (1850: 279, 382)	-
<i>Diplacodes lefebvreii</i> (Rambur)	Anonymous (1910)	-
<i>Libellula depressa</i> Linnaeus	McLachlan (1880)	-
<i>fulva</i> O.F. Müller	Seabra (1937)	-
<i>quadrifasciata</i> Linnaeus	Girard (1891)	-
<i>Orthetrum brunneum</i> (Fonscolombe)	Selys & Hagen (1850: 18)	-
<i>cancellatum</i> (Linnaeus)	Vandelli (1797)	-
<i>chrysostigma</i> (Burmeister)	Girard (1891)	-
<i>coerulescens</i> (Fabricius)	Selys & Hagen (1850: 23, 279)	-
<i>nitidinerve</i> (Selys)	Girard (1891)	-
<i>trinacria</i> (Selys)	Jahn (1996b)	-
<i>Selysiothemis nigra</i> (Vander Linden)	Lohr (2005)	-
<i>Sympetrum flaveolum</i> (Linnaeus)	Selys & Hagen (1850: 35, 279)	-
<i>fonscolombii</i> (Selys)	Santos (1883)	-
<i>meridionale</i> (Selys)	Santos (1883)	-
<i>sanguineum</i> (O.F. Müller)	Girard (1891)	-
<i>striolatum</i> (Charpentier)	Selys & Hagen (1850: 42, 279)	-
<i>Trithemis annulata</i> (Palisot de Beauvois)	Aguiar & Aguiar (1983)	-
<i>Zygonyx torridus</i> (Kirby)	Aguiar (1989)	30

- 7 When Selys & Hagen (1850) listed *Erythromma najas* from Portugal, they referred to J.C. Hoffmannsegg, adding however a question mark. This entry, most probably resulting from a confusion with *E. viridulum*, was accepted by Hagen (1866), Seabra (1937) and Nogueira & Silva (1970), but doubted by Navás (1907) and Aguiar & Aguiar (1985a), and rejected by Girard (1891). A recent larval record of the species (Cortes 1992) was certainly based on a mis-identification. Clearly *E. najas* must be omitted from the Portuguese checklist and also, in accordance with Ocharán (1988), from the Iberian odonate fauna.
- 8 Although *Ischnura elegans* is widespread in Spain (Ocharán Larrando 1987), it was only once recorded from Portugal, allegedly basing on a male deposited at MZCP (Seabra 1937). However, the only Portuguese specimen at MZCP today (cf. Williams 1990) is a female in such a bad condition that it cannot be reliably identified. As it also has one of the dubious “Coimbra” labels (see Discussion), we did not accept it as a voucher. The species therefore had to be rejected from the Portuguese checklist, even if its presence seems probable according to its Galician distribution (Cordero 1996), where it is currently expanding its range (A. Cordero in litt.).

- 9 The early larval record of “*Agrion* sp.” in Faial, Azores, (Guerne 1888) may have been *I. hastata* (cf. Cordero Rivera et al. 2005a). Originally reported as “*I. senegalensis*” (Valle 1940), this species was correctly identified by Belle & van Tol (1990).
- 10 All reports on *I. senegalensis* from the Azores refer to *I. hastata* (see note 9). The identity of an *Ischnura* species in Madeira, first introduced as “*Agrion maderae*”, later as “*I. senegalensis*”, is still unsolved (see Discussion). The occurrence of *I. senegalensis* in the Macaronesian Islands is restricted to Cape Verde (Martin 1908; G. Lehmann, A. Martens in litt.). Its presence in Madeira is unlikely, so it was omitted from the checklist.
- 11 *Nehalennia speciosa* was listed in the catalogue of odonates at MZCP (Williams 1990). This entry is based on a misidentification. The specimen in question is much too big for a *Nehalennia*, but could not be identified due to its bad condition.
- 12 The distributional range of *Platycnemis pennipes* in Spain is restricted to the Catalanian foothills of the Pyrenees (Ocharán Larrondo 1987). However there is also an historical entry in the list of Portuguese odonates by Selys & Hagen (1850), repeated by Hagen (1866). Although rejected by Girard (1891) and doubted by Aguiar & Aguiar (1985a), this record was included by Navás (1907), Seabra (1937), and Nogueira & Silva (1970). The only voucher specimen, a “Coimbra”-labelled female deposited at MZCP (Williams 1990), turned out to be a typical *P. latipes*. Previously Navás (1907) had discussed this confusion: “*P. pennipes* lives with *latipes* [in Catalonia], with which it probably has been confused several times”. Another problem is the recent records of larval *P. pennipes* made in the course of Portuguese limnological studies (Fontoura & Moura 1984; Graça et al. 1989; Cortes 1992). Such misidentifications probably result from the use of central European larval keys that do not cover the Iberian fauna. *P. pennipes* was omitted from the Portuguese checklist.
- 13 *Aeshna grandis* from Terceira, Azores, was confused with *Anax imperator*. This is evident from the detailed illustration in Sampaio (1904).
- 14 The first Madeiran record of *Anax ephippiger* refers to Porto Santo (Gardner 1963). Smit (1998) recorded it on Madeira itself.
- 15 *A. imperator mauricianus* was reported from Madeira (McLachlan 1883) but doubted by Selys (1887) and le Roi (1915). The subspecific status of *mauricianus*, described from the Pacific island Mauricius, has been generally rejected due to the excellent migratory potential of *A. imperator* (e.g. Pinhey 1961). Moreover if it will be shown that the name *mauricianus* in fact denotes a well-defined taxon, its range will be restricted to the sub-Saharan Afrotropics.
- 16 The first listing of *Gomphus vulgatissimus* referred to a single incomplete specimen at MZCP without an exact locality. Seabra (1937) suspected the existence of further specimens in this collection, originating from Ponte da Murcela [de Mucela] near Coimbra. This distinctly vague entry was adopted by Nogueira & Silva (1970) and Aguiar & Aguiar (1985a). An additional larval record from Rio Alva was published by Graça et al. (1989). Under consideration of many other doubtful larval records in limnological studies from Portugal, it was necessary to omit *G. vulgatissimus* from the checklist, pending confirmation by imaginal records. Nevertheless, its occurrence in Portugal is zoogeographically feasible, as there have been reliable records in the 1980s from the A Coruña

province in neighbouring Galicia (G.-M. Heintze in Jödicke 1996b; J. Hoffmann pers. comm.). Admittedly, this occurrence was not confirmed in the 1990s (A. Cordero pers. comm.), and it is noted that the species is generally limited to the north in the Iberian Peninsula (Ocharán Larrondo 1987).

- 17 *Onychogomphus forcipatus unguiculatus* was originally reported as *Gomphus forcipatus* (Linnaeus) (Selys & Hagen 1850). Compte Sart (1965) assigned it to *unguiculatus* for the first time.
- 18 As a species protected by the Bern Convention and the Fauna-Flora-Habitat (FFH) directive of the European Union, and listed on the IUCN Red List of threatened species, the status of *Ophiogomphus cecilia* in Portugal, as well as in whole Iberia, is of special importance. Seabra's (1937) listing of the species was based on a single male at MZCP collected at Coimbra. Obviously the same male was listed in the catalogue of Odonata at MZCP (Williams 1990). It belongs to a collection of various species, each represented by a single specimen with the "Coimbra" label (see Discussion), that is now missing. Nogueira & Silva (1970) and Aguiar & Aguiar (1985a), adopted this entry in their checklists. In the course of limnological studies in Portugal some larval records of *O. cecilia* were reported by Cortes et al. (1986), Graça et al. (1989), and Cortes & Monzón (1991). These records seemed to confirm the presence of the species in Portugal. Also at that time, larvae of *O. cecilia* were sampled in Jaén province, Spain, which "were compared with the Portuguese larvae of Dr. V. Cortes, in the University of Córdoba collection" (Picazo & Alba-Tercedor 1992). Based on these findings *O. cecilia* has generally been regarded as a species with a central and eastern European distribution, but with small, highly endangered relict populations in Iberia (e.g. Schorr 1996). Accordingly, it has a corresponding record in current official checklists or websites (e.g. IUCN 2003). On the other hand, the occurrence of *O. cecilia* in Iberia had already been rejected by Ocharán (1988) and Jödicke (1996b), and the Iberian larval records were regarded by Suhling & Müller (1996) as most doubtful. To shed light on this matter, we visited two of the sites with published records of *O. cecilia* larvae: Rio Olo N of Vila Real (cf. Cortes et al. 1986) on 02 viii 2005 and Rio Alva near Seia (cf. Graça et al. 1989) on 14 vi 2005. Both sites turned out to be mountain brooks at ca 950 m (Rio Olo), and 1,030 m a.s.l. (Rio Alva), with a substrate consisting chiefly of rock and larger pebbles. Larval sampling in Rio Olo yielded only very small gomphid larvae that could not be determined, and at both sites only *Onychogomphus uncatatus* was on the wing during our visits. With regard to altitude, substrate, and size, we judged both localities as unsuitable for *O. cecilia*. Further clarification of the matter was provided by examination of a crucial series of 12 larvae that had previously been determined as *O. cecilia* (with the kind permission of R. Cortes and J. Rocha, Vila Real). Upon thorough examination all actually were determined as *O. forcipatus unguiculatus*. In summary, (1) all Iberian larval records of *O. cecilia* could well be misidentifications, (2) the easily recognizable imago has never been observed in the Iberian peninsula, and (3) the only voucher specimen is lost and was associated with a collection of doubtful provenance (see Discussion). Hence, we reject the possibility that *O. cecilia* ever was part of the Iberian fauna. This opinion is the only sensible conclusion we can reach taking into account zoogeographical considerations.

Table 2. Odonata checklist of Portugal — species from the archipelagos of Madeira and the Azores, with references to the first records. From the Selvagens Islands only one observation has been reported by Báez (1985), presumably referring to a migrating *Anax imperator* in 1976; Malkmus (2002) lists *Sympetrum nigrifemur* from there but gives no reference to the source. An additional *Ischnura* species of unresolved identity has been recorded from Madeira, also an unidentified gomphid (see Discussion). ‘Note’ refers to comments on selected species.

Taxa	Madeira	Azores	Note
<i>Ischnura hastata</i> (Say)	—	Valle (1940)	9
<i>Ischnura pumilio</i> (Charpentier)	Rambur (1842: 278)	Navás (1933)	-
<i>Anax ephippiger</i> (Burmeister)	Gardner (1963)	—	14
<i>Anax imperator</i> Leach	Bowdich (1825: 169)	Navás (1933)	15
<i>Anax parthenope</i> Selys	Pelny (2006)	—	-
<i>Sympetrum fonscolombii</i> (Selys)	Hagen (1865)	Navás (1933)	26
<i>Sympetrum nigrifemur</i> (Selys)	Selys & Hagen (1850: 396)	—	27

- 19 A larval record of *Cordulegaster bidentata* from the Douro basin by Cortes & Monzón (1991) was considered to result from confusion with *C. boltonii*. In Iberia *C. bidentata* is restricted to the Pyrenean region.
- 20 Boudot & Jacquemin (1995) analysed the subspecific distribution of *C. boltonii* in Iberia: in continental Portugal *C. b. boltonii* (north) and a mixed population of *C. b. boltonii* and *C. b. immaculifrons* Selys (central) occur. Following Boudot (2001: fig. 11), the population in southern Portugal belongs to *C. b. iberica* Boudot & Jacquemin. This view is partly supported by photographs (taken by S. Geschke) of specimens from southwestern Portugal demonstrating the typical *iberica* coloration. However, the variability of *C. boltonii* within its range may be better interpreted in terms of a clinal variation with an increase of the yellow markings towards the hotter and dryer southwest. Such an interpretation would preclude subspecific names. In this respect it is worth noting that Ocharán Larrando (1987) demonstrated that the taxon *immaculifrons* in Spain could not be maintained as a valid subspecies due to the variability observed.
- 21 Vandelli (1797) was the first to report on Portuguese Odonata. One of the four listed species was “*Libellula aenea*”, which later was erroneously referred to as *Cordulia aenea*. Most likely, Vandelli’s *aenea* would have been the western Mediterranean corduliid, *Oxygastra curtisii*, which was still unknown to science in that time. Later, Seabra (1937) referred to one of the now lost “Coimbra” specimens at MZCP (see Discussion), when he maintained the entry of *C. aenea* in the Portuguese checklist. This was still acknowledged by Nogueira & Silva (1970) and Aguiar & Aguiar (1985a). Subsequently, its Iberian occurrence was rejected by Ocharán (1988), an opinion we endorse, as there is no reliable record known from Iberia.
- 22 Coimbra et al. (1996) applied, in a limnological study, the name *Crocothemis servilia* to a larva, which most likely belonged to *C. erythraea*. The Asiatic *C. servilia* must be omitted.

Table 3. Odonata taxa rejected from the checklist of continental Portugal, Madeira and the Azores. 'Note' refers to comments on selected species.

Taxa	Primary sources	Note
<i>Calopteryx haemorrhoidalis almogravensis</i>	Hartung (1996)	1
<i>virgo virgo</i> (Linnaeus)	P. Jahn in Jödicke (1996a)	2
<i>Lestes sponsa</i> (Hanseemann)	Seabra (1937)	4
<i>Coenagrion puella</i> (Linnaeus)	Sampaio (1904)	5
<i>Erythromma najas</i> (Hanseemann)	Selys & Hagen (1850: 177, with question mark); Cortes (1992)	7
<i>Ischnura elegans</i> (Vander Linden)	Seabra (1937)	8
<i>senegalensis</i> (Rambur)	McLachlan (1883: Madeira); Gardner (1963: Porto Santo); Valle (1940: Azores)	10
<i>Nehalennia speciosa</i> (Charpentier)	Williams (1990)	11
<i>Platycnemis pennipes</i> (Pallas)	Selys & Hagen (1850: 170, 279); Fontoura & Moura (1984); Graça et al. (1989); Cortes (1992)	12
<i>Aeshna grandis</i> (Linnaeus)	Sampaio (1904)	13
<i>Anax imperator mauricianus</i> Rambur	McLachlan (1883)	15
<i>Gomphus vulgatissimus</i> (Linnaeus)	Seabra (1937); Graça et al. (1989)	16
<i>Ophiogomphus cecilia</i> (Fourcroy)	Seabra (1937); Cortes et al. (1986); Graça et al. (1989); Cortes & Monzón (1991)	18
<i>Cordulegaster bidentata</i> Selys	Cortes & Monzón (1991)	19
<i>Cordulia aenea</i> (Linnaeus)	Vandelli (1797); Seabra (1937)	21
<i>Crocothemis servilia</i> (Drury)	Coimbra et al. (1996)	22
<i>Leucorrhinia dubia</i> (Vander Linden)	Seabra (1937)	23
<i>Orthetrum coerulescens anceps</i> (Schneider)	Malkmus (2002)	24
<i>Sympetrum depressiusculum</i> (Selys)	Seabra (1937)	25
<i>fonscolombii azorensis</i> Gardner	Gardner (1959)	26
<i>pedemontanum</i> (O.F. Müller in Allioni)	Seabra (1937)	28
<i>vulgatum vulgatum</i> (Linnaeus)	Vandelli (1797); Girard (1891)	29

- 23 Seabra (1937) was astonished to find two specimens of *Leucorrhinia dubia* at MCZP with labels indicating an origin of the Coimbra region. His listing was adopted by Nogueira & Silva (1970) and Aguiar & Aguiar (1985a) but rejected by Ocharán (1988). The two specimens obviously were lost when Williams (1990) compiled the MCZP Odonata catalogue. In Iberia *L. dubia* is restricted to the Pyrenees (Michiels & Verheyen 1990).
- 24 *Orthetrum coerulescens anceps* was confused by Malkmus (2002) with the widespread *O. c. coerulescens*. However, Williams (1990) listed two Portuguese specimens under the synonym of *O. anceps*, *O. ramburii* (Selys). Both specimens were still present at MZCP and had been misidentified, actually being *O. c. coerulescens* and *O. brunneum*.
- 25 Seabra's (1937) listing of *Sympetrum depressiusculum* was doubted by Aguiar & Aguiar (1985a) and never confirmed. Also Williams (1990) did not mention any specimens at MZCP. Hence the species was rejected from the checklist. The species does not occur in the Iberian Peninsula (Ocharán 1988). However, it is included in the Iberian checklist (Compte Sart 2004), obviously referring to the unconfirmed record by Seabra (1937).
- 26 Gardner (1959) described *S. fonscolombii* ssp. *azorense* from Pico, Azores, which was judged to be an infrasubspecific entity (Belle 1992). To establish agreement in gender with *Sympetrum* the original spelling *azorensis* must be amended.
- 27 The occurrence of *S. nigrifemur* in Madeira, as *Diplax striolata*, was noted by Selys & Hagen (1850). Its description followed many years later (Selys 1884).
- 28 The entry of *S. pedemontanum* in the checklist of Seabra (1937) was based on a single "Coimbra" male at MZCP (cf. Williams 1990), which is now lost (see Discussion). The species was also listed by Aguiar & Aguiar (1985a) from the same source. Due to the absence of a voucher specimen we omitted the species. Future records from Portugal are rather unlikely, as the record by J. Hoffmann (in Jödicke 1996b) from adjacent Galicia could not be confirmed in the last decade (A. Cordero in litt.). The species is very rare in Spain; there is only one other reliable record from Puigcerdà, Pyrenees, confirmed by voucher specimens (Navás 1906; Pibernat & Abós 1996, pers. comm.).
- 29 All early records of *S. v. vulgatum* from Portugal and Spain most likely belonged to *S. striolatum* (Navás 1908: 113). However, the species was also listed in subsequent papers (e.g. Aguiar & Aguiar 1985a). All supposed "*vulgatum*" specimens in the Portuguese collections checked by us were misidentified. *S. vulgatum* is rare in Spain (Ocharán Larrondo 1987), and its taxonomic status is not sufficiently resolved. Ocharán (1985) described the population from Asturias (N Spain) as a new pale subspecies, *S. v. ibericum*. Also a pair from Catalonia, caught in the 19th century, was assigned to this subspecies (Jödicke 1993). We have now seen other specimens from Catalonia, collected most recently by B. Garrigós, matching the characters of the nominotypical subspecies. If ssp. *ibericum* should be maintained in the future, it might be a candidate for the Portuguese checklist, but ssp. *vulgatum* is definitely not present.
- 30 Aguiar's (1989) first record of *Zygonyx torridus* lacked sufficient details, but his voucher specimens were recently found to be well-labelled (Kunz et al. 2006).

DISCUSSION

The 63 species from continental Portugal (Table 1) make up 83% of the Iberian Odonata fauna. Seventy-six species are known from continental Spain (Ocharán 1988: 70 spp.; plus Ferreras Romero 1989: *Sympetrum sinaiticum* Dumont; Michiels & Verheyen 1990: *Leucorrhinia dubia*; Anselin & Hoste 1996: *Coenagrion pulchellum*; Martín Casacuberta 1997: *Coenagrion hastulatum* [Charpentier]; Dantart & Martín 1999: *Somatochlora metallica* [Vander Linden], and *Leucorrhinia pectoralis* [Charpentier]). This means that 13 Iberian species have so far not been recorded from Portugal; most of these species are restricted in Spain to the Pyrenees and their foothills. On the other hand, the Portuguese list contains species from the Macaronesian islands, *Ischnura hastata* and *Sympetrum nigrifemur* (Table 2), that do not belong to the Iberian fauna.

Altogether, it was necessary to remove 22 taxa from the Portuguese checklist. A major source of dubious cases was the single specimens of obviously foreign species that had been deposited at MZCP and had been supplied, either erroneously or by intent, with incorrect labels pretending a Portuguese origin. This obviously occurred prior to 1937, as Seabra (1937) referred to many of them. Unfortunately the drawers in which most of these specimens had been stored vanished over time and are no longer traceable. However, if we regard the MZCP catalogue by Williams (1990) as reliable in this context, the relevant species are at least *Lestes sponsa*, *Ophiogomphus cecilia*, *Cordulia aenea* and *Sympetrum pedemontanum* – for each of them a single specimen existed in the collection, labelled “Coimbra”. Additionally, single specimens of *Gomphus vulgatissimus*, *Somatochlora metallica*, *Leucorrhinia pectoralis*, *Sympetrum danae* (Sulzer) and *S. nigrescens* Lucas – all without locality and date – are also listed in the catalogue, and they probably belonged to the same set of alien species that reached the Coimbra collection late in the 19th or early in the 20th century.

Other dubious “Coimbra” specimens at MZCP were erroneously assigned to *Platycnemis pennipes*, *Aeshna viridis* Eversmann and *Sympetrum sinaiticum* (as “*decoloratum* Selys”). As they are still present in the collection, we reviewed their identification: they actually belong to *P. latipes*, *A. cyanea* and *S. meridionale*, respectively. The MZCP catalogue also contains a single female of “*Nehalennia speciosa* (Charpentier)” labelled with another Portuguese locality (see note 11). The only voucher specimen of *Aeshna juncea* at MZCP (cf. Williams 1990) was checked and identified as a female *A. cyanea*. In the genus *Sympetrum* we were confronted with chronic misidentifications (see e.g. Jödicke 1997); this applied not only to MZCP but to all collections studied. Incorrect identifications are not confined to older records – in the course of limnological studies during the last two decades, six odonate species have been falsely reported to occur in Portugal (Table 3).

The occurrence of several other potentially controversial species, of which only single or very few historical records existed, was recently confirmed: namely *Aeshna affinis* (S. Ferreira, J.M. Grosso-Silva unpubl.), *A. juncea* (Brändle & Rödel 1994; S. Ferreira, J.M. Grosso-Silva unpubl.), *Brachytron pratense* (Ferreira & Grosso-Silva 2003), *Gomphus simillimus* (Weihrach & Weihrach 2003), *Libellula fulva* (Dijkstra 1997; A. Gardiner pers. comm.) and *Sympetrum flaveolum* (S. Ferreira, J.M. Grosso-Silva unpubl.).

In Madeira, two unidentified *Gomphus* specimens were reported in the mid 19th century. Selys & Hagen (1858) referred to a specimen reported by T.V. Wollaston by the name *G. lucasii* Selys. Hagen (1865) noted a specimen in the collection of O. Heer, which was taken by G. Hartung. Hagen did not see this specimen but he supposed that it was probably *G. simillimus*. McLachlan (1883) and Gardner (1963) considered both specimens to belong to the same species. This conclusion is almost certainly correct but the real identity remains open. At least we can state that *G. lucasii* is an unlikely candidate, because it is an inhabitant of the north-eastern Maghreb and does not occur in Morocco (next to the island). The Iberian residents *G. graslinii*, *G. pulchellus*, and *G. simillimus* are all possible candidates, but the most probable identity of these specimens is *G. simillimus maroccanus* Lieftinck, provided that they really belonged to the genus *Gomphus*.

Even more exciting is the still unidentified second *Ischnura* species in Madeira, besides *I. pumilio* (see Table 2). It was first mentioned by Selys & Hagen (1850) who referred to a species with the label name "*Agrion Maderae*" (nom. nud.) in the collection of Rambur, which was acquired by Selys. For many years further information was sparse: Hagen (1865) wrote that he did not know the "*A. Maderae*" of Selys, while Selys (1876) listed the locality "Madeire?" for *I. graellsii* – a first speculation about the identity of the Madeiran species. McLachlan (1883) reported one male and one female in Selys' collection as being in bad condition, but determined as *senegalensis* by Selys. Selys (1887) himself was less sure because he first (p. 46) set a question mark behind Madeira as a locality for *I. senegalensis*, but later (p. 66) he added to the list of records: "Madère, d'après une exemplaire de la collection Rambur". This identification seemed to be confirmed when Gardner (1963) reported on a series of *I. senegalensis* captured during an expedition to the island of Porto Santo (archipelago of Madeira) in February 1958. Unfortunately, neither the specimen(s) in the collection of Selys nor the series of Gardner have been critically examined so far. Le Roi (1915) was absolutely correct to doubt the occurrence of a species in Madeira that is missing in northwestern Africa. We now know that all "*I. senegalensis*" records from the Canary Islands belong to *I. saharensis* (Belle 1982; Hämäläinen 1986) and those from the Azores to *I. hastata* (see Notes). McLachlan (1883) explicitly noted a male of the Madeiran *Ischnura* in Selys' collection, and Gardner (1963) failed to mention that he collected females only. Hypothesizing that all potential Macaronesian populations of *I. hastata* are parthenogenetic (like the Azorean ones), this species might be excluded from Madeira due to the existence of males. Hence, the identity of the enigmatic ischnuran in Madeira is most probably *I. saharensis*.

There are several species that might be added to the Portuguese checklist in future. The first candidate is *Ischnura elegans* which occurs in neighbouring southern Galicia and is expanding its range (A. Cordero in litt.). *Lestes sponsa* also has recently been found in high abundance around lake Sanabria (León prov.) near to the border of Portugal (A. Cordero in litt.). Because *Gomphus vulgatissimus* and *Sympetrum pedemontanum* have recently been deemed extinct in Galicia (A. Cordero in litt.), their occurrence in Portugal is rather unlikely. *S. vulgatum ibericum* is known from Asturias, so it may also appear in Portugal. We also expect *S. sinaiticum*, which is distributed along the Mediterranean coast of Spain from Catalonia to Andalusia (see Jödicke 1997). Another group of potential immigrants are the libellulids from northern Africa, all of which are excellent fliers that should be able

to cross the Strait of Gibraltar. Most of them are already known from both sides of the Mediterranean Sea but *Pantala flavescens* (Fabricius), *Trithemis arteriosa* (Burmeister), and *T. kirbyi ardens* Gerstäcker have never been recorded in western Europe so far (cf. Ocharán 1988; Ferreira & Weihrauch 2005). An interesting possible migrant is *Orthetrum coerulescens anceps*, which would invade the range of the nominotypical subspecies. Klingenberg & Martens (1996) have described an intermediate specimen between *anceps* and *coerulescens* from Andalusia, which indicates some gene flow between both taxa in southern Iberia, under the assumption of occasional immigration of *anceps*.

The present checklist of Portuguese Odonata covers as far as we are aware all historical records for which vouchers specimens are available, and is zoogeographically consistent. Without doubt, the most spectacular inhabitant is *I. hastata* – the Nearctic zygopteran that successfully settled in the Azores. The Azorean population is unique within the whole order with its exclusively parthenogenetic reproduction (Cordero Rivera et al. 2005a, 2005b), a finding of general interest to evolutionary biologists (e.g. Sherratt & Beatty 2005). Another surprise is the verification of *Coenagrion pulchellum*. Due to its rarity in Spain, prior to our discovery of the museum specimen we intended to reject this species from the checklist. This example demonstrates that zoogeographical analysis is always subject to revision in the light of new data.

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Colour plate I. Habitus of *Diplacodes* species — (a) mature male *D. deminuta* (Okavango Delta, Botswana, 1 February 2006) with pruinosity, notably pale face, Pt and appendages, and pale streaks up to S7; (b) female *D. deminuta* (Okavango Delta, Botswana, 1 February 2006) with notably pale appendages and pale streaks up to S7; (c) mature male *D. pumila* sp. nov. (Kisolanza Farm, Tanzania, 21 September 2001) with notably dark face, Pt and appendages, and pale streaks up to S9; (d, f) female *D. pumila* sp. nov. (Kisolanza Farm, Tanzania, 21 September 2001) with contrasting rufous thoracic dorsum and pale streaks extending to notably dark appendages; (e) immature male *D. pumila* sp. nov. (Kisolanza Farm, Tanzania, 21 September 2001), showing an intermediate development between immature and mature condition (rather like Plate IIc and II d). Photos by Jens Kipping (a, b) and Viola Clausnitzer (c-f).



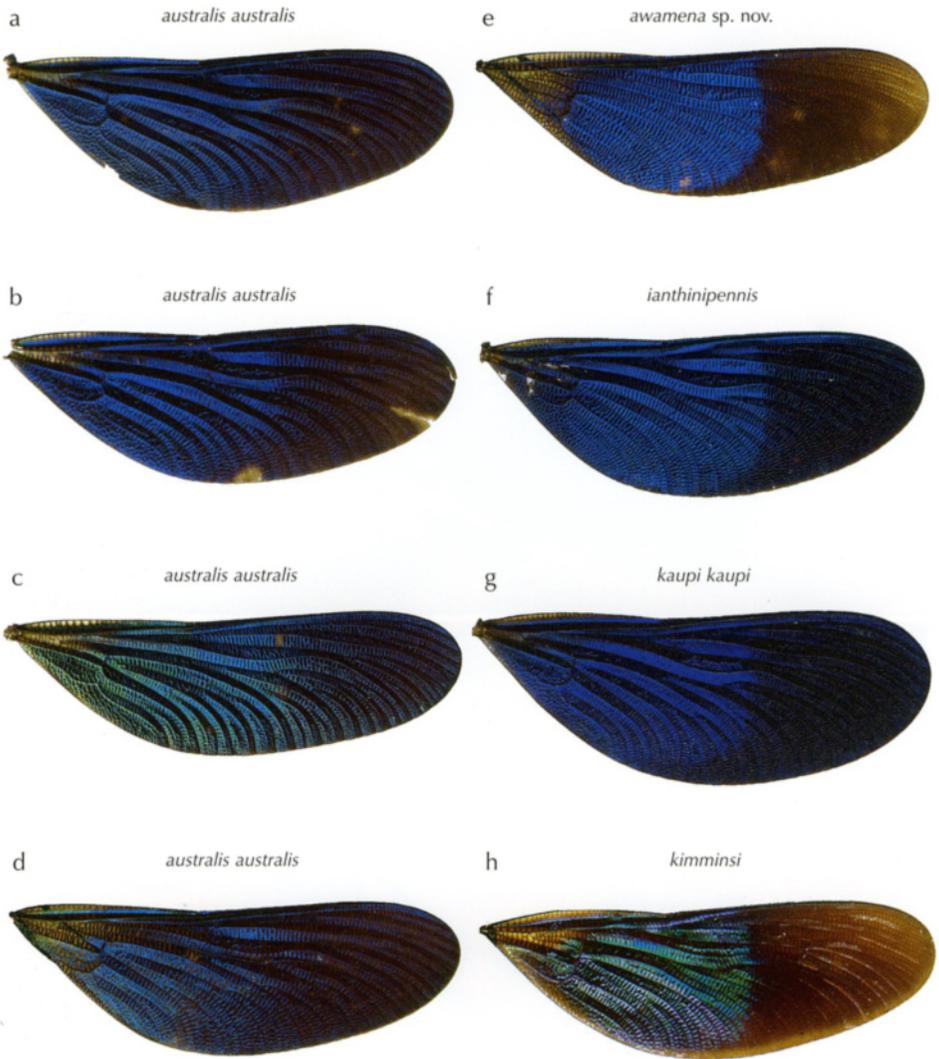
Colour plate II. Habitus of *Diplacodes* species — (a) mature male *D. lefebvrei* (Nouil, Tunisia, 16 June 2002); (b-f) female *D. lefebvrei* show age-dependent darkening: (b) teneral (Nouil, Tunisia, 26 May 2001); (c) immature (Jemna oasis, Tunisia, 25 May 2001); (d) mature (same data as c); (e) fully mature (Blidet, Tunisia, 16 June 2002); (f) aged (same data as c); (g) mature male *D. luminans* (South Luangwa NP, Zambia, 4 January 2002); (h) female *D. luminans* ovipositing (Ghanzi, Kalahari, Botswana, 17 January 2006). Photos by Bernd Kunz (a-f), KD Dijkstra (g) and Jens Kipping (h).



Colour plate III: Robberflies (Asilidae) exsanguinating Odonata — (a) *Philonicus* cf. *albiceps* with *platycnemis pennipes*. Nestos Delta, Greece, 28 June 1992. Photo by Frank Hecker <Naturfoto.Hecker@t-online.de>; — (b) *Stenopogon* sp. with *Crocothemis erythraea*. Les Salins de Giraud, France, 31 July 2002. Photo by Elfi Miller.



Colour plate IV: The two european *Pyrrhosoma* species — (a) *P. elisabethae* male; Kalávrita, Greece, 6 June 2003. Photo by Jean-Pierre Boudot. — (b) *P. nymphula* male; Rosenberg, Germany, 24 June 2006. Photo by Bernd Kunz.



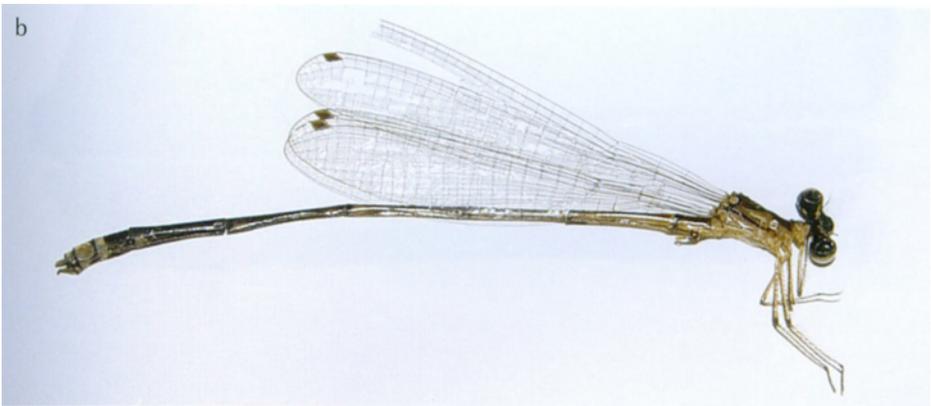
Colour plate V: Hindwings of male *Neurobasis* — (a) northern variety from Tami River, Papua Province, Indonesia; (b) northern variety from coastal Morobe Province, PNG; (c) northern variety from New Britain, PNG; (d) southern variety from Pimaga, Southern Highlands Province, PNG; (e) Pimaga area, Southern Highlands Province, PNG; (f) north-east Irian Jaya, Indonesia; (g) northern Sulawesi; (h) south-east PNG.



Colour plate VI: Underwater oviposition in two *Euphaea* species — (a) *Euphaea decorata* ovipositing into *Acorus tatarinowii*. Submergence lasted for 59 min, with two brief re-surfacing episodes after 38 min and 53 min. Photo by Graham Reels. — (b) Female *Euphaea subcostalis* submerged in stream at Gunung Mulu, Sarawak. The female submerged to a depth of ca 3 cm and stayed underwater for 20-25 s. Photo by Rory Dow.



Colour plate VIIa: *Andinagrion garrisoni* sp. nov. in tandem — La Angostura, Jujuy Province, Argentina, 8 January 2006. Photo by Natalia von Ellenrieder.



Colour plate VIIIb: *Coeliccia mingxiensis* sp. nov. — holotype from China, Fujian Province, Mingxi County (26°24'N, 116°56'E), 26 July 2004, leg. Xu Q.-h. Scan by Xu Qi-han.



Colour plate VIII: Artistic impression of courtship in *Neurobasis kaupi*, with the male displaying his brilliant blue hindwings to the perched female. This painting by Bert Orr will be the cover illustration of a forthcoming book — Härmäläinen, M. & A.G. Orr: "*Neurobasis* and *Matronoides*: the Metalwing Demoiselles of the eastern tropics (Odonata: Calopterygidae)", to be published in 2007 by the Brothers of Saint Gabriel in Thailand, Bangkok.